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Detection of Intrapericardial Hematoma After Open Heart Surgery: The Roles of Echocardiography and Computed Tomography

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Two patients who had right atrial compression caused by intrapericardial hematomas after coronary artery bypass grafting and aortic valve replacement are described. During the course of postoperative evaluation, each patient underwent an echocardiographic examination followed by computed tomography of the chest. Two-dimensional echocardiography visualized the hematomas in both cases. Computed tomography played a useful adjunctive role by further clarifying their nature, location and extent.

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Echocardiography has become the diagnostic technique of choice for the detection of pericardial effusion (1,2). However, hemorrhage into the pericardial space after open heart surgery may accumulate over a restricted region of the heart and be difficult to detect by two-dimensional echocardiography. Although computed tomography is infrequently used to screen patients for pericardial effusion, extracardiac collections of fluid or thrombus may be visualized clearly with this technique (3).

We describe two patients who had right atrial compression caused by intrapericardial hematoma after coronary artery bypass grafting and aortic valve replacement. These cases illustrate the diagnostic potential of two-dimensional echocardiography for the detection of pericardial hematomas, as well as some of the pitfalls that may be encountered. The role of computed tomography in characterizing the nature and extent of these masses is demonstrated and discussed.

Case Reports

Case 1

A 72 year old woman underwent saphenous vein bypass grafting and aortic valve replacement. At surgery, closure of the aortotomy was complicated by local bleeding, and hemostasis was obtained with difficulty. The pericardium was not closed. Because of intermittent atrial fibrillation, anticoagulation with warfarin (Coumadin) was begun on the seventh postoperative day; she was discharged 5 days later and was doing well. During the ensuing weeks, her prothrombin time was maintained between 1½ to 2½ times control. She continued to feel well until 4 weeks later, when she experienced chest pain and syncope.

On admission to the hospital, her pulse rate was 95 beats/min and her blood pressure was 150/60 mm Hg. Pulsus paradoxus was not present. Her jugular veins were markedly distended. A grade 2/6 systolic ejection murmur was heard over the upper left parasternal area. The prosthetic valve sounds were normal. Her lungs were clear to auscultation, and the remainder of the cardiac examination was unremarkable. The chest roentgenogram and electrocardiogram were unchanged from those obtained at the time of postsurgical discharge. The prothrombin time was 18.7 seconds (control = 9.0 to 12.0).

Two-dimensional echocardiography (Fig. 1). A two-dimensional bedside echocardiographic examination showed a large, slightly refractile mass that obliterated most of the right atrial cavity.

Computed tomography (Fig. 2). To ascertain whether the mass was intraatrial or extracardiac and delineate its extent, we examined the heart with computed tomography. A 10 × 9 × 7 cm, well circumscribed, dense, avascular extracardiac mass bound by pericardium on its lateral aspect was visualized in the right anterior portion of the mediastinum. It compressed the right atrium and a portion of the right ventricle and displaced the superior vena cava, ascending aorta and pulmonary artery. Its density (attenuation coefficient) was typical of hematoma.

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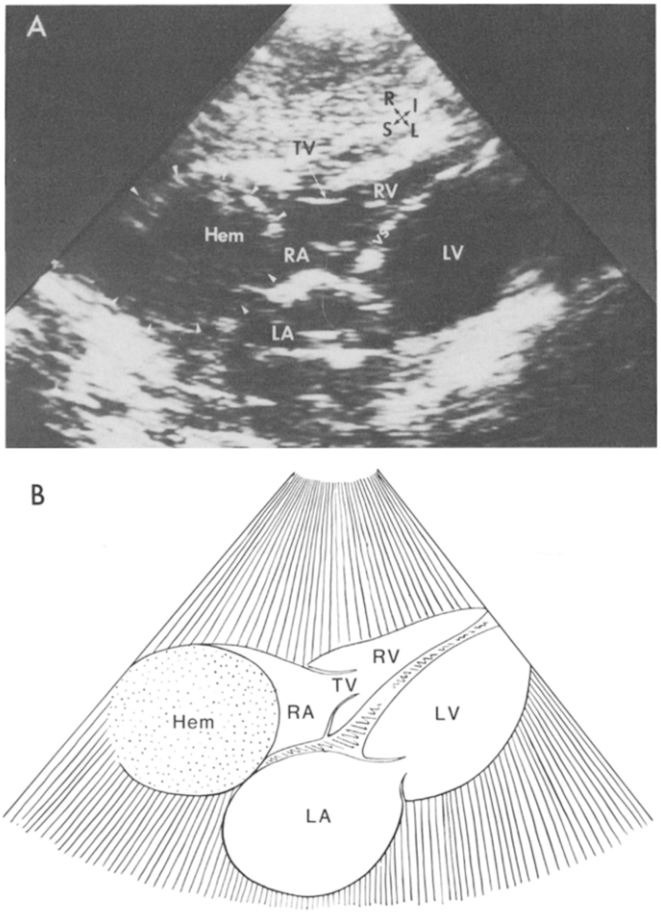

Figure 1. Case 1. Two-dimensional echocardiogram, subcostal long-axis view **(A)** and diagram **(B)** showing a large hematoma (Hem) with a highly refractile margin (**arrowheads**) surrounding a relatively echolucent center. The right atrium (RA) is almost obliterated. I = inferior; L = left; LA = left atrium; LV = left ventricle; R = right; RV = right ventricle; S = superior; TV = tricuspid valve; vs = ventricular septum.

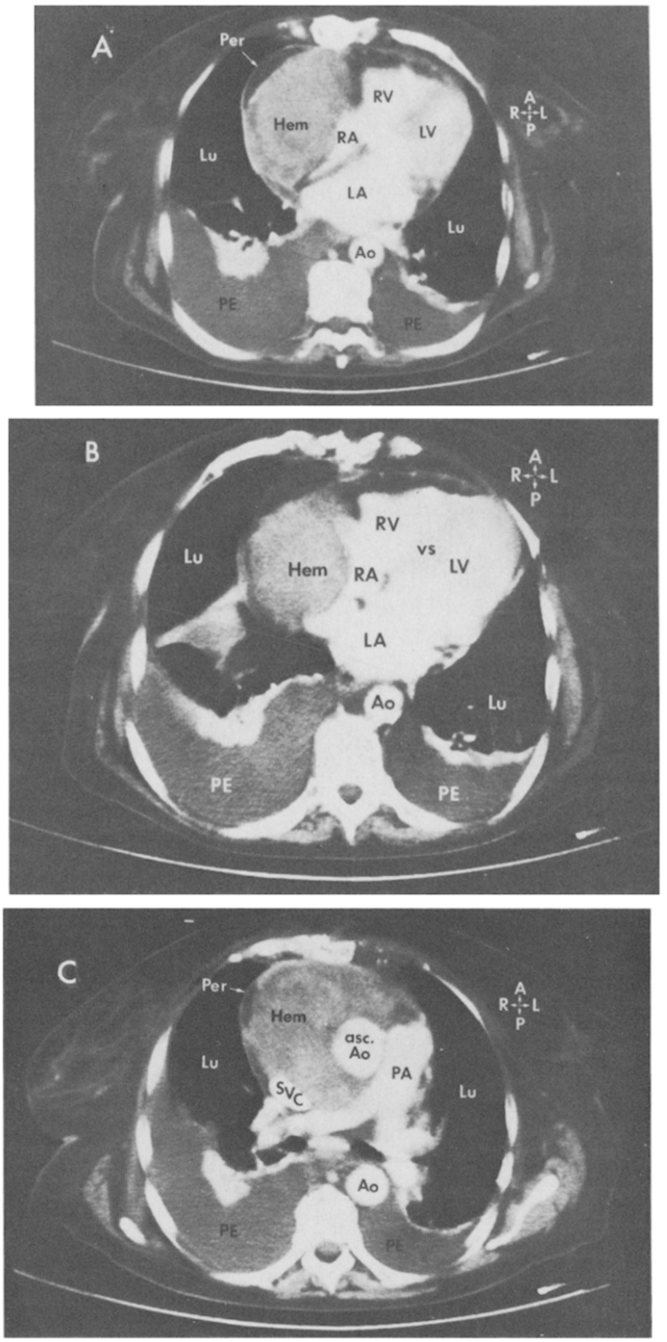

Figure 2. Case 1. Computed tomograms of the heart. **A**, Hematoma (Hem) is bound laterally by pericardium (Per) and medially by compressed right atrial (RA) and right ventricular (RV) walls. Extension over the right ventricle is seen. **B**, Tomographic plane comparable with that shown in the echocardiogram in Figure 1. **C**, Hematoma (Hem) surrounds the proximal ascending aorta (asc. Ao) and displaces it and the pulmonary artery (PA) to the left and compresses the superior vena cava (SVC). A = anterior; Ao = descending aorta; Lu = lung; P = posterior; PE = pleural effusion; other abbreviations as in Figure 1.

Operative findings. The patient underwent operation, and a large organizing thrombus was removed from the pericardial space anterolateral to the right atrium. The pericardium, which was thickened, was also removed. The vein grafts were found to be intact. No site of active bleeding was found. Her postoperative course was uneventful. Anticoagulation with warfarin (Coumadin) was reinstituted. One year after discharge, she was feeling well.

Case 2

A 60 year old man underwent uneventful coronary artery bypass grafting and aortic valve replacement. No systemic anticoagulation was given after operation. One week after surgery, the patient described vague intermittent pains in the chest and arms.

Two-dimensional echocardiography (Fig. 3). Echocardiography revealed a mass that encroached on the superior and lateral aspects of the space normally occupied by the right atrium. Although this mass was believed to be an extracardiac hematoma, we were unable to exclude an intraatrial thrombus with certainty.

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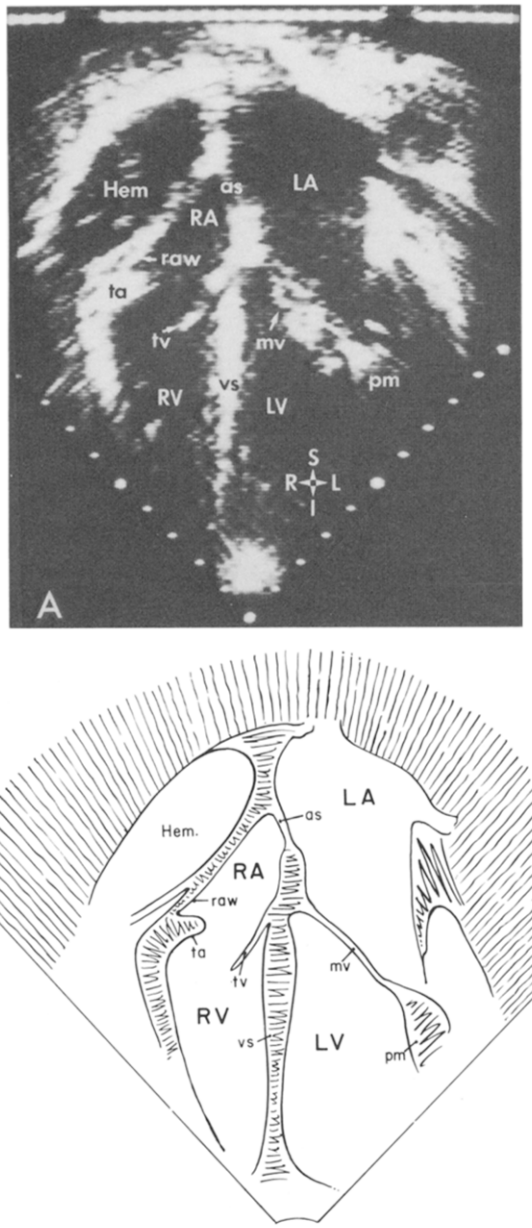

Figure 3. Case 2. Two-dimensional echocardiogram, apical four chamber view **(A)** and diagram **(B)** showing hematoma (Hem) with its refractile margin and relatively echolucent center compressing the lateral aspect of the right atrium (RA). A short segment of right atrial wall (raw) continuous with the tricuspid valve anulus (ta) appears to pass between the mass and atrial cavity. as = atrial septum; mv = mitral valve; pm = papillary muscle; other abbreviations as in Figures 1 and 2.

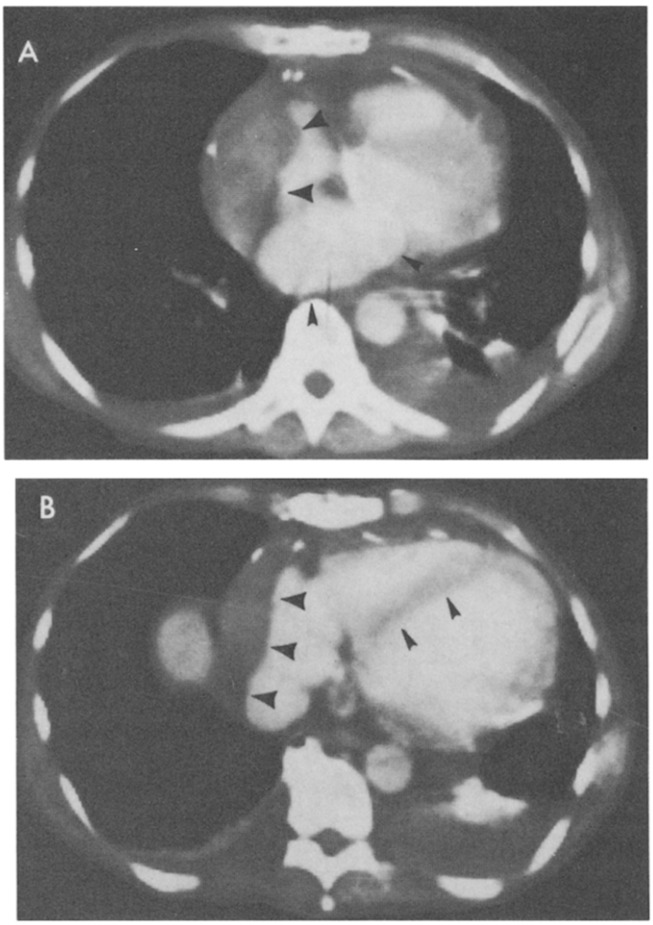

Figure 4. Computed tomograms obtained during infusion of contrast material. Cardiac chambers are opacified, but hematoma is not. **A**, Interface **(large arrowheads)** between a hematoma and a compressed right atrium is sharp. The left atrium **(small arrowheads)** is unaffected. **B**, Inferior portion of the right atrium is less compressed by hematoma **(large arrowheads).** The ventricular septum **(small arrowheads)** is readily identifiable.

Computed tomography (Fig. 4). A computed tomographic examination of the heart revealed a large mass external to the right atrium that compressed the atrium on its superior, lateral and anterior margins. The mass extended from the root of the aorta to the lower margin of the right atrium. As in Case 1, the density and avascularity of the mass strongly suggested the diagnosis of hematoma.

During the next 5 days, there was no clinical evidence of cardiac tamponade. The chest pain resolved after treatment with aspirin. The patient was dismissed on the 12th postoperative day. Two months later, he was feeling well. A repeat two-dimensional echocardiogram at that time was essentially unchanged. He continues to be observed on an outpatient basis.

Discussion

Localized pericardial hematomas. In most patients, pericardial effusions are nonlocalized and can thus be confidently diagnosed or excluded on the basis of an echocardiographic examination. However, a localized pericardial hematoma may be difficult to diagnose with echocardiography. As illustrated by our case reports and those of others (4–7), a localized hematoma may occur early or late after open heart surgery and not uncommonly is localized anterior and lateral to the right atrium.

Role of two-dimensional echocardiography in diagnosis of pericardial hematomas. A complete two-dimensional echocardiographic examination is essential. Although the mass in Case 2 was well seen in several standard views (8), the hematoma in Case 1 was only identifiable with certainty in the subcostal long-axis view (Fig. 1). Because blood progressively becomes more echo-dense as it clots (9,10), one should not exclude pericardial hemorrhage on the basis of the absence of an echo-free space around the heart. Echocardiographically, a hematoma may appear anywhere on the continuum from sonolucent to highly refractile. The right atrium may be almost obliterated by the rounded hematoma (Fig. 1 and 2). If the hematoma is sonolucent or only slightly refractile and selectively compresses the right atrium, care must be exercised not to mistake the hematoma for the cardiac chamber itself. The use of appropriate high gain and low reject settings may reveal that an area of apparent sonolucency is, in fact, a somewhat refractile mass.

Once a mass is seen, the differentiation of an intrapericardial hematoma that compresses the right atrium from an intraatrial thrombus may be difficult. Echocardiographic features that suggest an intrapericardial hematoma include a superolateral location, a smooth, rounded margin that projects into the right atrium and an echolucent center surrounded by a highly refractile margin that comprises the edge of the hematoma and the contiguous pericardium or right atrial wall. Central echolucent areas have been described in atrial myxomas, but they are uncommon in intraatrial thrombi (11). A helpful clue observed in our Case 2 was a small segment of the right atrial wall cephalad to and continuous with the tricuspid valve anulus that appeared to pass between the mass and the right atrial cavity (Fig. 3).

Role of computed tomography in diagnosis of pericardial hematomas. Computed tomography has proved valuable in clarifying the nature and extent of extracardiac and intracardiac masses (3,12,13). Computed tomography can detect, localize and characterize hematomas. Such characterization is best accomplished if both precontrast and postcontrast images are obtained. For the differentiation of an intraatrial thrombus from an intrapericardial hematoma, a particularly helpful observation is the extension of the extrinsic hematoma beyond the boundaries of the right atrium. In general, computed tomography is better suited than echocardiography for clearly demonstrating the extracardiac extent of a mass. In addition, computed tomography is considerably less operator-dependent than echocardiography and, thus, there is less likelihood of overlooking an extracardiac lesion.

Several computed tomographic characteristics are useful in differentiating intrapericardial hematomas from other soft tissue masses such as tumors. This occurs because: 1) although hematomas generally decrease in radiographic density over time, they remain more dense than soft tissue; 2) pericardium is visualized along the lateral border of the mass (Fig. 2); and 3) vascular extracardiac masses, such as tumors, usually show an increase in radiographic density after the administration of contrast medium, whereas avascular masses, such as hematomas, show no such increase in density during infusion of contrast material.

Conclusion. When screening for a postoperative pericardial hematoma, two-dimensional echocardiography is the diagnostic technique of choice. It is also a convenient means of observing a hematoma for further enlargement if the patient's condition is stable and surgical evacuation is not undertaken. However, with echocardiography alone, one may overlook an extracardiac mass or not be able to distinguish with certainty an intrapericardial hematoma from an intracavitary mass. Adjunctive computed tomography is of value in these cases because it permits differentiation of an extracardiac from an intracavitary mass, precise determination of the extracardiac extent of a mass and characterization of a mass as a probable hematoma by its relative density and response to the intravenous administration of contrast material.

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